Space Weather Technical Forecast

Issued on Tuesday, 23 November 2021 at 00:07 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: No significant activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the last 24 hours, with no significant X-ray flare activity observed at GOES-16. There are three sunspot regions on the visible disc, AR2896 Hrx/Alpha and AR2897 Axx/alpha are both stable unipolar spots. A new region Bxo/beta developed to the northwest AR2897, but remains very weak and faint. There are currently two large filaments in southeastern disc, but these appear to be stable at the time of writing. No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1 erratically declined from just over 600 km/s to around 540 km/s, although a brief spike in speed to just over 650 km/s was observed at 22/0050-0100 UTC. Density was average throughout, below 10 ppcc. The interplanetary magnetic field strength (IMF), Bt, was weak, below 5 nT, with a north-south component varying between -4 and +4 nT. The phi angle was predominately negative (towards the Sun) throughout. These parameters were consistent with a declining coronal hole fast wind, from CH20/-. Resultant geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained at Background levels. The high energy electron flux (greater than 2 MeV) continued to fluctuate between background and moderate levels, peaking at 702 pfu at 21/1700UTC. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), but with a very slight increasing trend. At 23/0000 UTC 1.5e7 integrated pfu was observed.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Very Low, with only a slight chance of C-class flares due to the small and simple sunspots on the Earth-facing disc.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Over the next couple of days Earth's interaction with the fast wind of CH20 is expected to wane and geomagnetic activity is expected to be predominantly Quiet. However, further enhancement in the solar wind is possible later in the forecast period from coronal hole 21 and 22, but with low confidence. This brings a chance of geomagnetic activity increasing to Quiet to Unsettled with a chance of Active intervals day 3 and day 4 (25th and 26th)

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels. The high energy electron flux (greater than 2 MeV) is expected to rise as geomagnetic activity wanes from the current elevated solar wind. The magnitude of this rise is uncertain, however diurnal oscillations peaking at High flux (greater than 1000 pfu) are likely. The associated 24-hour integrated fluence has a chance of breaching Active (greater than 1e8 integrated pfu) in the period, but more likely remaining just below this level.

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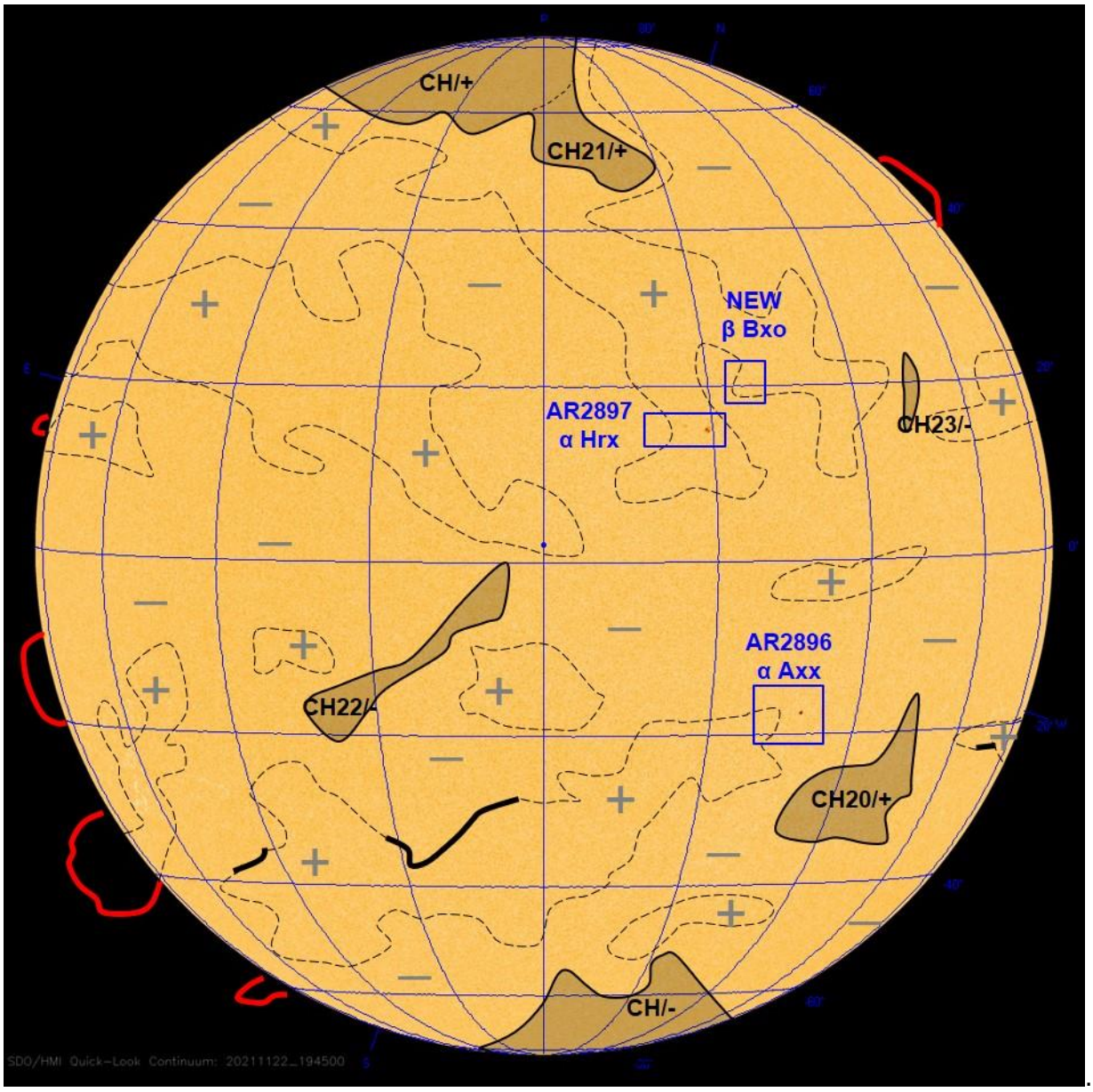
Figure 1. Solar Analysis Valid 22/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs. Solar wind speeds are currently declining as Earth transitions through the fast wind of CH20/-, having fallen to 540km/s from a peak of around 700km/s. The next potential enhancement is from CH21/+ on day 3 (25th), which is a southern extension from the northern crown. Any potential enhancement from this feature is likely to be limited however, due to its northern latitude, leading to very low confidence in any associated increase in wind speed or geomagnetic activity. Furthermore, no associated enhancement has been observed at STEREO A. CH22/- then has the potential to follow with a further enhancement on day 4 (26th), after a recent northwestward extension of this equatorial coronal hole. This is also low confidence however.

Geomagnetic activity is expected to be Quiet, with unsettled spells at first, increasing to Quiet to Unsettled with a chance of Active intervals with any enhancement from either of the coronal hole fast winds on days 3 or 4 (25th or 26th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Observed solar winds

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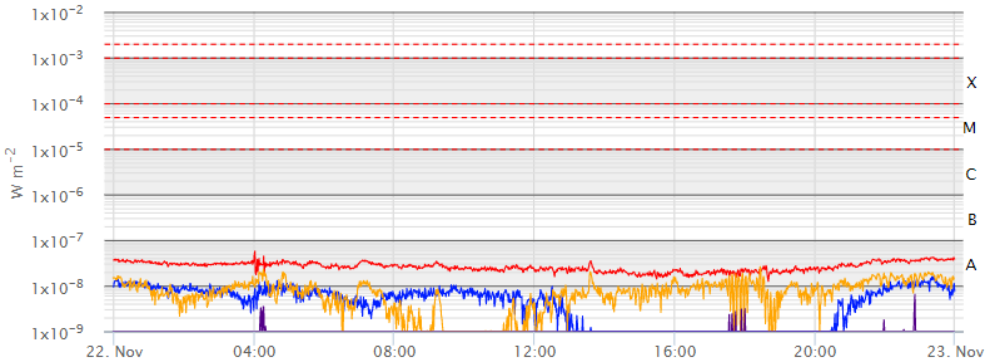
Radio Blackouts - X-Ray Flares:

Solar Activity is currently Very Low, and expected to remain at this level, with only three small and simple sunspots on the visible disc. AR2896 Axx/Alpha and AR2897 Hrx/Alpha are both mature and stable unipolar regions. A further new sunspot Bxo/Beta has also developed to the northwest of AR2897, but remains a very small bipolar region. There is also the potential for another region to rotate onto the disc during the next 24 hours from over the northeast limb. This risk is associated with a bright region visible on STEREO A euvi imagery, but the presence of any spot or subsequent increased flare risk cannot be assessed it has rotated into view.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/17 X-ray flux



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16, remained at Background levels during the previous 24 hours, and is currently forecast to remain at this level through the period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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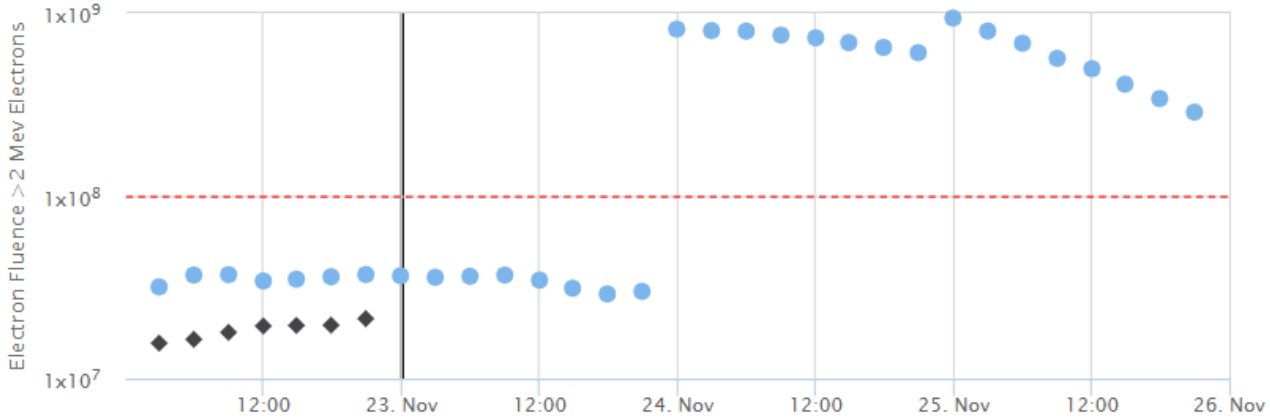
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 at GEO has been diurnally fluctuating between background and moderate levels but with peak levels gradually rising each day. This pattern is likely to continue over the coming days but with an increased chance of High levels (> 1000 pfu) being reached as any compression of the Van Allen belts from the current fast wind of CH20/- continues to subside. Any elevated flux has the potential to drop out again later in the period with any further fast wind arrival from CH21, however this is very low confidence.

Corresponding electron fluence is expected to continue to see an increasing trend, likely staying below the Active (1e8 integrated fluence) levels, but with a slight chance of rising above, mainly day 2. This risk subsides by the end of the period. MOSWOC REFM indicates is giving a good indication of expected values up to T+24, but should be disregarded beyond this point, with the magnitude of the increase shown not expected.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	20	20	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: GOES-16 >2MeV Electron Fluence with REFM



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